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(54) **Vehicle**

(57) A car for carrying at least one person includes right-hand and left-hand, hollow structures between which the pers n sits. Transverse bulk-heads (15, 16) define a space to accommodate the person and the hollow structures extend beyond the bulkheads. Front and rear portions (19, 22, 20 and 24) of the right-hand and left-hand hollow structures are arrang d for telescoping movement, in middle members 18, 23 in the event of collision.

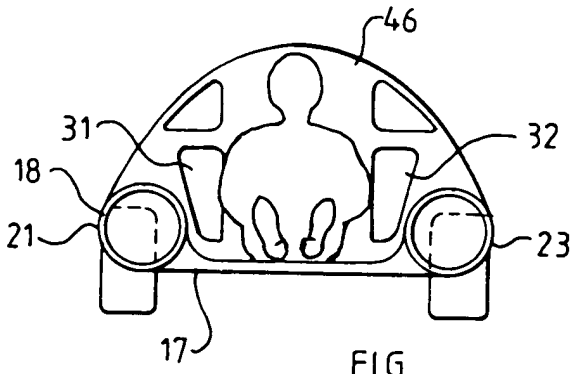

FIG 2

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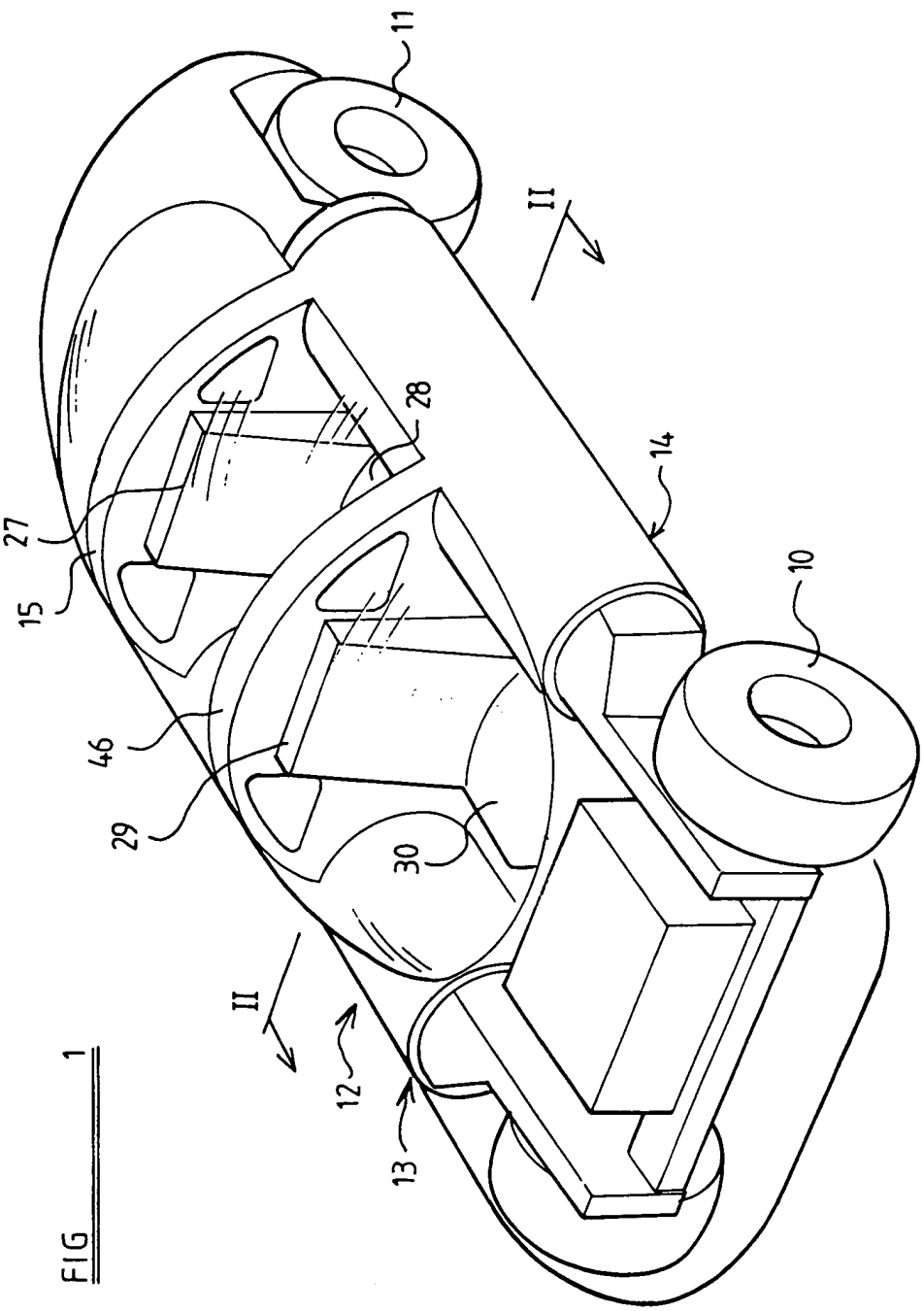


FIG 1

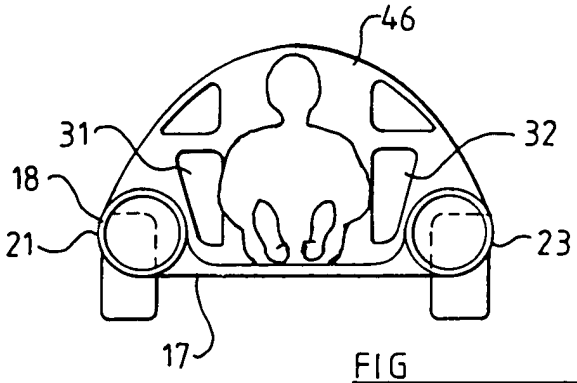


FIG 2

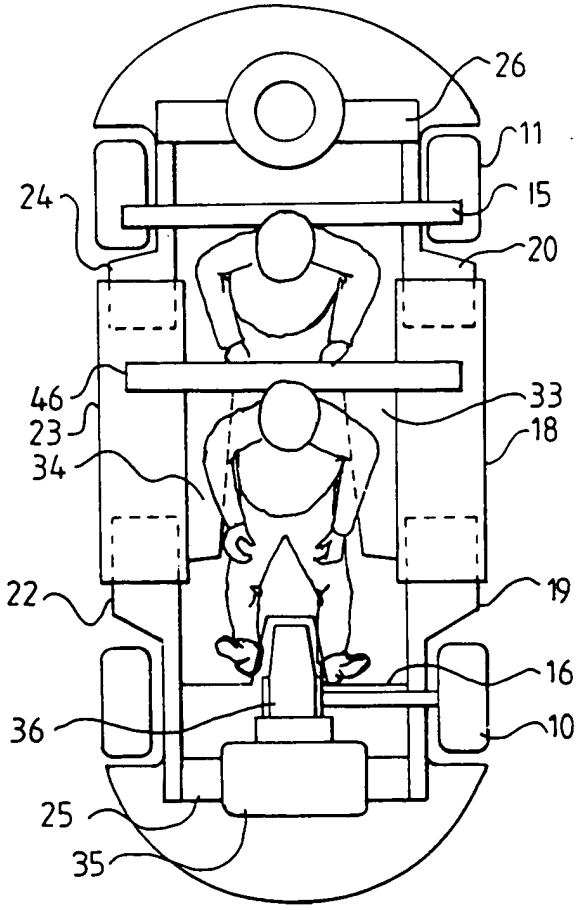
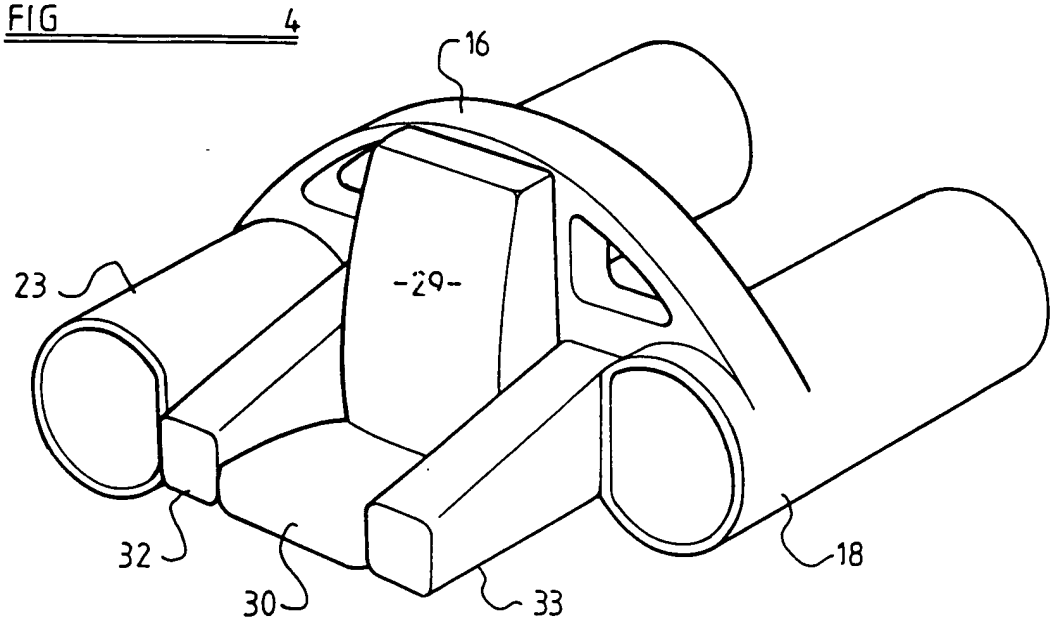


FIG 3

FIG 4



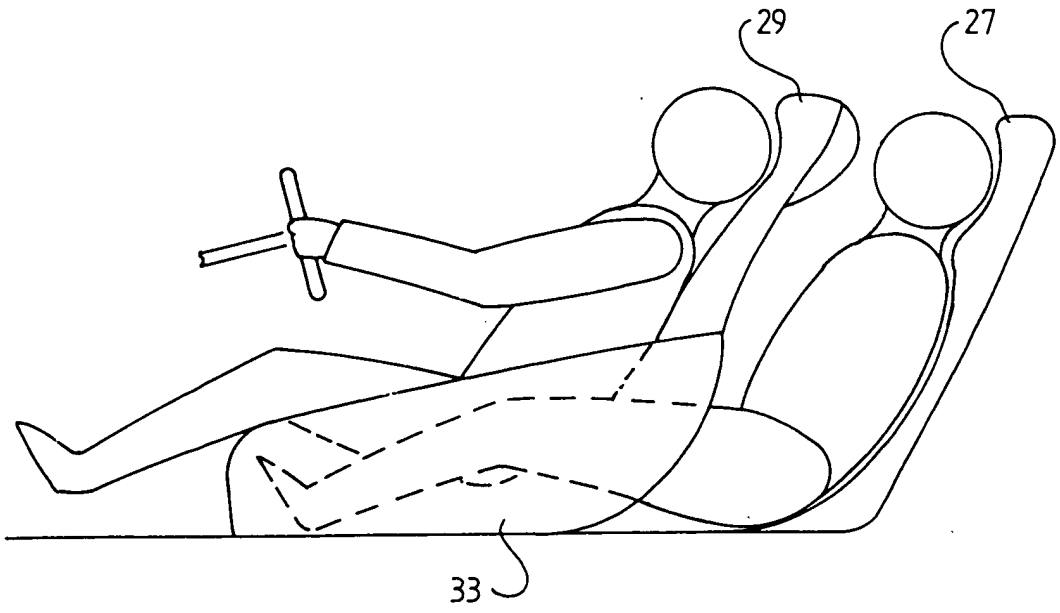


FIG 5

FIG 6

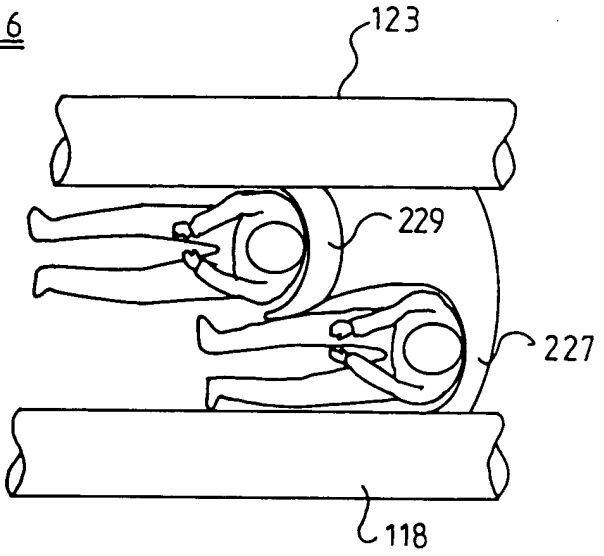


FIG 7

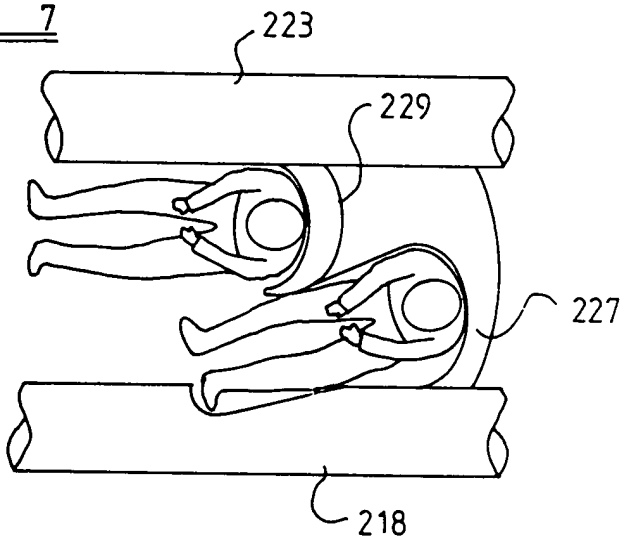
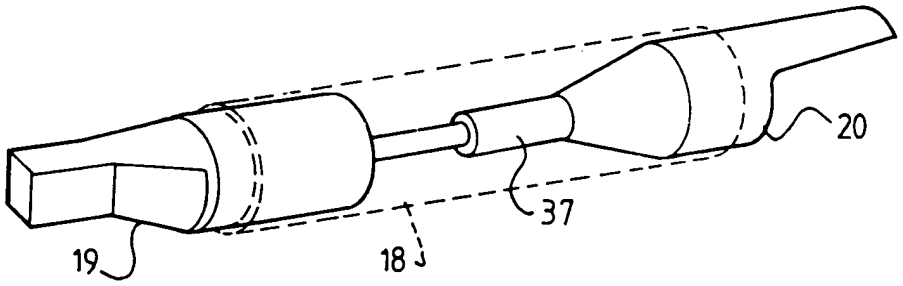


FIG 8



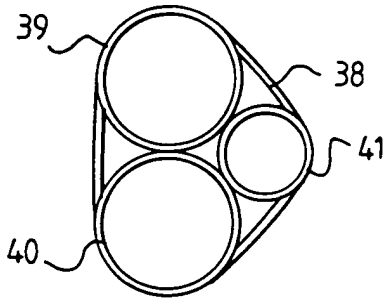


FIG 9

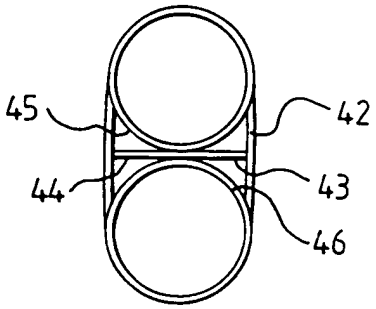


FIG 10

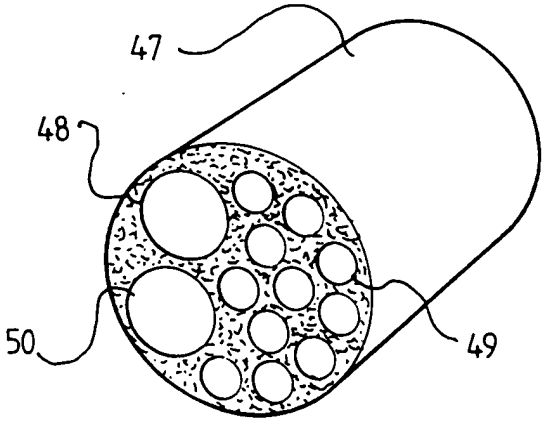


FIG 11

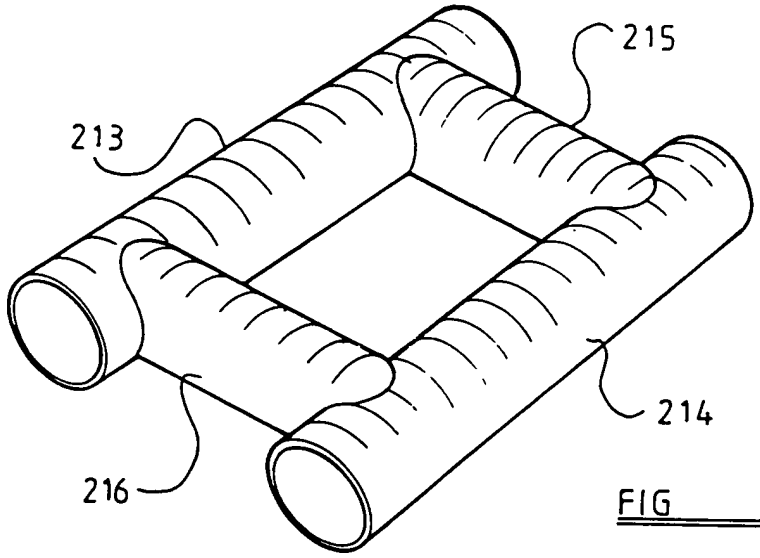


FIG 12

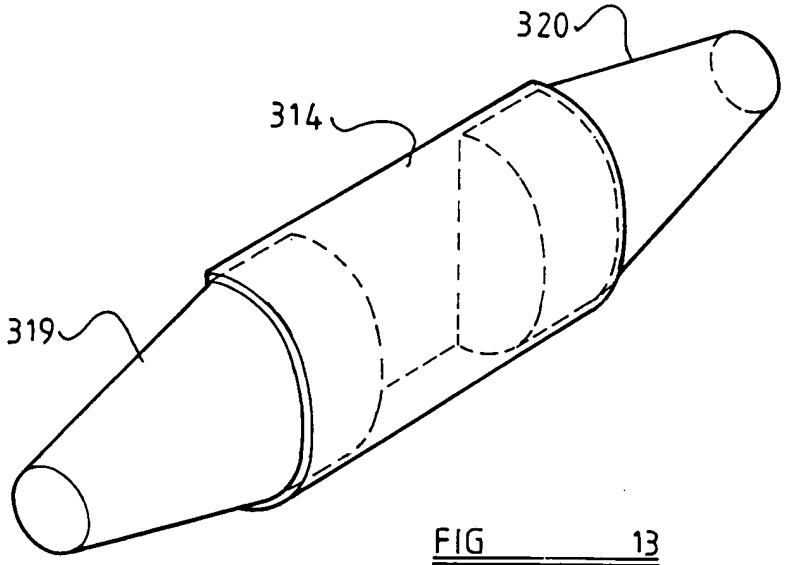


FIG 13

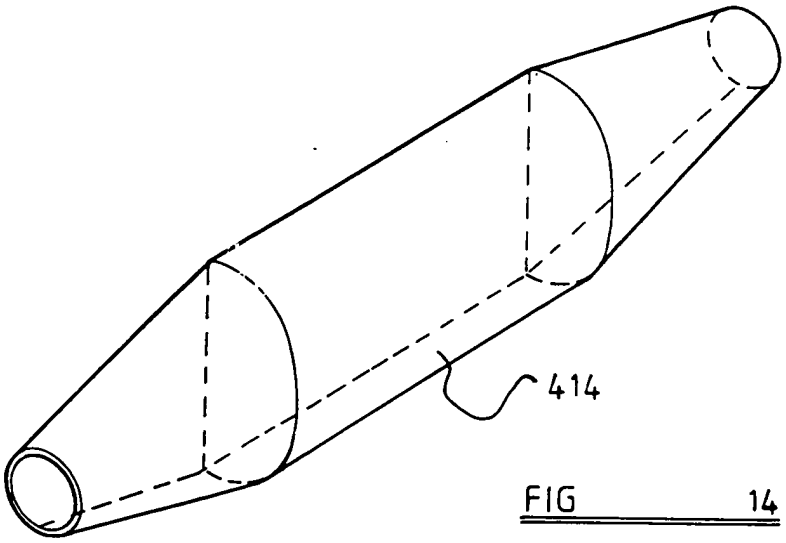


FIG 14

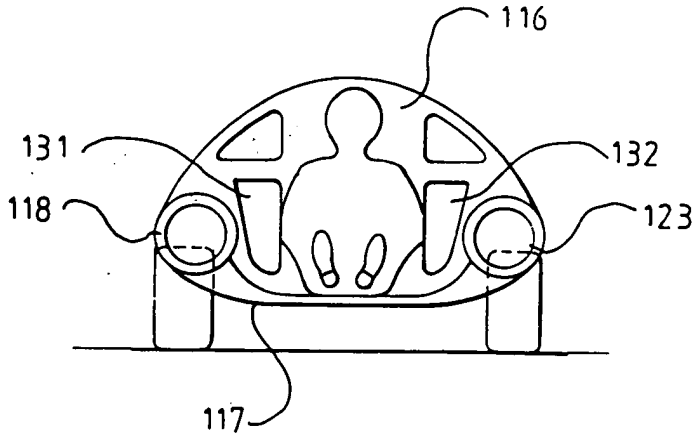


FIG 15

Title: Vehicle

Description of Invention

The present invention relates to a vehicle defining an internal space for accommodating one or more persons.

According to a first aspect of the invention, there is provided a vehicle defining an internal space for accommodating a person and comprising right hand and left hand hollow structures which are spaced apart in a direction transverse to the direction of normal travel of the vehicle and a seat for supporting the person in a position between the hollow structures, wherein the hollow structures extend forwards and rearwards beyond the space for accommodating the person.

In a vehicle embodying the first aspect of the invention, the hollow structures protect the person inside the vehicle in the event of the vehicle being involved in a collision. The hollow structures may be designed to collapse progressively under side and/or end impact, thereby dissipating kinetic energy.

The vehicle preferably comprises front and rear end members spanning the gap between the hollow structures. The end members may have respective connectors in telescopic relation with respective ones of the hollow structures so that, if the end members are subjected to impact acting in a direction towards the internal space defined by the vehicle, they will resist intrusion of extraneous structure into that space and will move telescopically relative to the hollow structures of the vehicle. The hollow structures may contain energy-absorbing means which can yield under the effect of impact on either the end members or directly on the hollow structures.

The hollow structures are preferably of the same height and this is preferably more than ¼ of the height of the seat. Generally, the seat will comprise a lower part and an upwardly extending back rest.

The hollow structures preferably have the same width and this is preferably greater than one tenth of the minimum separation between the hollow structures. The width of the hollow structures is preferably greater than ¼ of the width of the seat.

In the preferred vehicle, the internal space is sufficiently large to accommodate two persons and there are provided first and second seats disposed one behind the other, both seats being between the hollow structures and the hollow structures extending forwards and rearwards beyond both seats and beyond the entire space for accommodating the two persons.

The seats may be positioned with a centre of each seat lying on a longitudinal centreline of the vehicle. Alternatively, respective centres of the seats may be offset from the centreline of the vehicle to opposite sides thereof. In either case, the arrangement can be such that the hollow structures can yield under side impact without injuring occupants of the vehicle through a distance which is large, relative to the distance under which the bodies of known vehicles can yield under side impact without injuring occupants.

In a case where the vehicle comprises two seats and the centre of each seat lies on a longitudinal centreline of the vehicle, then spaces for the legs of a person occupying the rear seat are preferably provided between the front seat and the hollow structures. Each of the hollow structures may have an external, elongated, tubular extension projecting from the hollow structure towards the other hollow structure and arranged with its length approximately parallel to the direction of normal travel, the extension being open at least its rear end and lying at least partly between the front seat and the hollow structure to accommodate the leg of a person supported by the rear seat.

Examples of vehicles embodying the present invention will now be described, with reference to the accompanying drawings, wherein:

FIGURE 1 shows a diagrammatic representation of certain parts of a vehicle,

FIGURE 2 shows diagrammatically a cross section of the vehicle on the line II-II of Figure 1,

FIGURE 3 shows diagrammatically a plan view of the vehicle of Figure 1,

FIGURE 4 illustrates an alternative vehicle by a diagrammatic representation of a part of a body of the vehicle,

FIGURE 5 illustrates a further alternative vehicle diagrammatically by a partial cross section in a vertical plane parallel to a longitudinal centreline of the vehicle,

FIGURE 6 illustrates a third alternative vehicle by a diagrammatic representation of a plan view of certain parts of the vehicle,

FIGURE 7 illustrates a fourth alternative vehicle by a view similar to Figure 6,

FIGURE 8 is a diagrammatic representation of a perspective view of a hollow structure which may be incorporated in any of the alternative vehicles illustrated, together with certain associated parts of the vehicle,

FIGURES 9 and 10 illustrate further modified vehicles by showing diagrammatically vertical cross sections through modified hollow structures which may be incorporated in the vehicles,

FIGURE 11 shows diagrammatically a vertical cross section through a further modified structure which may be incorporated in the vehicles,

FIGURE 12 is a diagrammatic representation of a basic chassis structure which may be incorporated in a further modified vehicle,

FIGURE 13 illustrates diagrammatically a further example of a hollow structure which may be incorporated in a modified vehicle,

FIGURE 14 is a representation, similar to Figure 13, showing a further example of a hollow structure which may be incorporated in a modified example of the vehicle and

FIGURE 15 is a view similar to Figure 2 illustrating a further modification of the vehicle of Figure 2.

The vehicle illustrated in Figures 1, 2 and 3 of the accompanying drawings is a wheeled vehicle intended for use on roads and to carry two persons. The example illustrated has four wheels. A left-hand front wheel is represented at 10 in the drawing and a left-hand rear wheel is represented at 11. Corresponding wheels are provided at the right-hand side of the vehicle and at least two of the wheels are driven. For example, the front wheels may be driven. At least the front wheels are also steerable.

The vehicle comprises a body 12 which is mounted on the wheels and which includes a right-hand hollow structure 13 and a left-hand hollow structure 14. Between the structures 13 and 14, the body defines a space for receiving two persons who are referred to herein as the driver and the passenger. A rear boundary of this space is defined by a bulk head 15 which extends between the hollow structures 13 and 14 and a front boundary of the space is defined by a front bulk head 16 indicated in Figure 3. The structures 13 and 14 extend rearwards beyond the rear bulk head 15 and extend forwards beyond the front bulk head 16. At the bottom of the space which accommodates the driver and passenger, there is a floor 17 which spans the gap between the structures 13 and 14. In the example illustrated in Figures 1, 2 and 3, there are two floor layers and the lower one of these is substantially flat and extends between the lowest parts of the structures 13 and 14. The space which accommodates the driver and the passenger is preferably closed above the level of the structures 13 and 14 by a roof which extends forwards from the upper margin of the rear bulk head 15. The highest part of the roof is preferably at approximately the same level as the upper margin of an intermediate bulk head 46 and the roof may incorporate movable panels or be movable as a unit to facilitate access to the interior of the vehicle body 12. The roof may be entirely transparent or partly transparent.

Preferably a part of the roof between the rear bulkhead 15 and the intermediate bulkhead 46 forms a rear door and a part of the roof extending forwards from the intermediate bulkhead forms a front door. The rear door may be of the hatch back type. The doors may be pivoted on the bulkheads and/or

on the hollow structures 13 and 14 or one of them. The bulkheads of the body 12 or some of them are preferably hollow, tubular structures.

The left-hand hollow structure 14 comprises a rectilinear, elongated, hollow middle member 18 which, in the example illustrated, has a cylindrical profile along its entire length. The middle member 18 is of tubular form and may incorporate internal reinforcements, for example the annular reinforcement shown at 21 in Figure 2.

The hollow structure 14 further comprises front and rear members 19 and 20, both of which are in telescopic relation with the middle member 18 at opposite ends thereof. The members 19 and 20 may be elongated and arranged with their lengths parallel to the length of the middle member. The transverse cross sectional shapes of the front and rear members vary along these members. However, each of these members preferably includes a portion of uniform shape in transverse cross section which cooperates with the middle member 18. The front and rear members may, for example, slide within respective end portions of the middle member during front and rear impact. As manufactured, the front and rear members are fixed with respect to the middle member, for example by rivets which will shear if the body is subjected to severe front or rear impact.

The right hand hollow structure 13 comprises front, middle and rear members 22, 23 and 24 corresponding respectively to the front, middle and rear members of the structure 14. The vehicle body 12 further comprises a front end member 25 which spans the gap between the front members 19 and 22 and is connected to or is united with those members. The front end member 25 is preferably spaced forwards from the front bulk head 16. The gap between the rear members 20 and 24 is spanned by a rear end member 26 which is connected with or united with the rear members and is spaced rearwards from the rear bulk head 15. The front and rear end members 25 and 26 are preferably hollow. It will be noted that members including 15, 16, 17, 18, 23 and 46 collectively form a frame surrounding the space for the driver and passenger. This structure can alternatively be described as a safety cell for containing the driver and passenger.

A seat for supporting the passenger is disposed at the front of the rear bulk head 15 and lies between the middle member 18 and the middle member 23. The seat includes a backrest 27 which may be incorporated in the bulk head 15 and a lower part 28 extending forwards from the backrest. A seat for supporting the driver is spaced forwards from the passenger seat and comprises a backrest 29 and a lower part 30 extending forwards from the backrest. The backrest 29 is preferably incorporated in a bulk head 46 which extends laterally to the middle member 18 and the middle member 23 and upwards to the roof of the body 12. This bulk head may be constructed and arranged in a manner similar to that of the rear bulk head 15 but the bulk head 46 which incorporates the back rest 29 is spaced away from the middle members 18 and 23 adjacent to the floor of the body by apertures 31 and 32 through which the legs of a passenger can extend. It will be noted that the lower part 30 of the driver's seat is spaced from the middle members 18 and 23 sufficiently for the legs of the passenger to be accommodated between the driver's seat and the hollow structures 13 and 14. The backrests include headrests for the passenger and driver.

The overall height of the middle members 18 and 23 preferably exceeds ¼ of the height of the backrest 29 and ¼ of the height of the backrest 27. It will be understood that these backrests may extend upwards to the roof of the body 12. More preferably, the height of the middle members 18 and 23 exceeds one third of the height of the backrests.

The width of the middle members 18 and 23 exceeds ¼ of the width of the lower part 30 of the front seat and of the lower part 28 of the rear seat. Typically, the width of the middle members is approximately equal to the width of the lower parts of the seats. It will be understood that the width of the lower parts of the seats is substantially less than the spacing between the hollow structures 13 and 14. The minimum spacing between the middle members 18 and 23 is no more than ten times the width of these members and is more preferably no more than five times the width of these members. In a case where these

members do not have a uniform width, then the comparison is made with the maximum width of the middle members.

The distance from the driver's seat 29, 30 to external surfaces of the vehicle at opposite sides of the vehicle are more than one half of the width of the seat. Accordingly, in the event of a side impact with the vehicle, collapse of the vehicle body from the external surface for a distance which is approximately half of the width of the seat can occur without injury necessarily being caused to the driver. As can be seen from Figure 2, the maximum width of the vehicle occurs at a level above the level of the lowest part of the floor 17. When the vehicle stands on a horizontal surface, the maximum width of the vehicle occurs at a level which is spaced above that surface by a distance which is more than the vertical dimension of each of the hollow structures 13 and 14. Preferably, the level of the maximum width of the vehicle is spaced above the surface on which the vehicle stands by a distance which is more than one and a half times the vertical dimension of each of the hollow structures 13 and 14. However, this distance is preferably no more than three times the vertical dimension of the hollow structures. The level of the maximum width of the vehicle is above the level of the centre of gravity of the vehicle.

Figure 15 illustrates a modification of the shape of the transverse cross section of the vehicle of Figure 2. In Figure 15, parts of the vehicle corresponding to those shown in Figure 2 are identified by like reference numerals with the prefix 1. The modified vehicle of Figure 15 differs from that of Figure 2 in that the level at which the maximum width of the vehicle occurs is spaced somewhat further from a level surface on which the vehicle stands. In this example also, the level of maximum width of the vehicle is above the level of the centre of gravity of the vehicle. In the arrangement of Figure 15, the level at which the maximum width of the vehicle occurs is at least approximately the same as the level of the centre of gravity of the torso of the driver and the level of the centre of gravity of the torso of the passenger. This arrangement reduces the risk

of either the driver or the passenger being thrown over one of the hollow structures at a side of the vehicle, in the event of side impact.

In the modified vehicle of Figure 15, each of the hollow members is spaced above a horizontal surface on which the vehicle stands by a distance exceeding the height of the hollow member. Furthermore, the floor 117 is inclined downwardly from each of the hollow members and is generally convex towards the ground. With the exception of the differences hereinbefore mentioned, the arrangement of the vehicle of Figure 15 is the same as that of the vehicle illustrated in Figures 1, 2 and 3.

The middle member 18 has an elongated, tubular, external extension 33 which projects from the member 18 towards the middle member 23. This extension is open at its rearward end and extends forwards from the backrest 29 of the front seat to define a space for receiving the left hand leg of the passenger. The front end of the extension 33 may be closed. The extension is arranged with its length extending generally in the direction of normal travel of the vehicle. The height of the extension may vary along its length, being greater at its rear end. It will be noted that the extension 33 lies generally between the lower part 30 of the front seat and the middle member 18. The extension may be formed integrally with the middle member 18 or secured to the middle member. A corresponding extension 34 is provided on the middle member 23 to accommodate the right leg of the passenger.

The extensions 33 and 34 may be omitted, there being provided between the front seat and the hollow structures 13 and 14 spaces to accommodate the legs of a passenger occupying the rear seat. Furthermore, in a case where structures to enclose the legs or parts of the legs of the passenger are provided, these structures may be formed on the floor or on the front seat, rather than on the hollow side structures.

The floor of the vehicle body 12 illustrated in Figures 1, 2 and 3 includes an upper layer which is not flat and which may incorporate or be secured to parts of the extensions 33 and 34 and of the lower seat parts 28 and 30.

For driving the front wheels of the vehicle, there is provided a motor 35 which is disposed between the front members 19 and 22. The front end member 25 may be attached to or may be incorporated in a housing of the motor. Alternatively, the front end member may be spaced from the motor so that there is some degree of freedom for rearwards movement of the front end member relative to the motor. The motor 35 may be an internal combustion engine or an electric motor. There is also provided a transmission indicated at 36 for transmitting drive from the motor to the front wheels. The transmission may include a gearbox or torque converter. The motor 35 may lie entirely between the front members 19 and 22. Alternatively, the motor may protrude forwards beyond the front members. Furthermore, the motor could lie entirely forwards of the front members.

Respective motors may be provided for each of two or all of the four wheels of the vehicle. Suitable motors are electric motors and hydraulic motors. These motors may be housed substantially within the associated wheels. In a case where one or more electric motors is provided, the or each motor may be used for braking and serve as an electrical generator during braking. In a case where one or more electric motors is provided, batteries for supplying power to the motor or motors may be distributed around the vehicle body and housed in spaces defined by the body, for example within bulk heads or within the floor structure.

The front and rear of the vehicle are approximately semi-circular, as viewed in plan, to minimise interaction in impact with other vehicles. Fairings may be provided over and around the wheels. The hollow structures extend laterally outwards as far as or beyond the outer faces of the wheels.

A suspension for the wheel 10 may be attached to the front member 19 at a position spaced forwards from the middle member 18. Adjacent to the wheel 10, the transverse cross section of the front member 19 may be considerably smaller than the transverse cross section of the middle member 18, to provide a space for accommodating the wheel 10 and allowing it to swivel for steering.

In a case where the motor 35 is an internal combustion engine, a fuel tank may be accommodated adjacent to the rear end member 26. A battery and a spare wheel also may be accommodated in the body 12 near to the rear of the body. The fuel tank, battery and spare wheel may be accommodated mainly between the rear members 20 and 24. Alternatively, the fuel tank, spare wheel and battery may be accommodated entirely or mainly to the rear of the rear members 20 and 24. It will be noted that the transverse cross section of the rear member 24 is smaller adjacent to the wheel 11 than it is adjacent to the middle member 18, in order to provide a space for the wheel. The rear member 24 may extend only beside the wheel or both beside and above the wheel.

The engine or other motor for driving the vehicle may alternatively be provided adjacent to the rear of the vehicle. In this case, the transmission may be arranged for providing drive to rear wheels of the vehicle. Generally, the front wheels will be the only steerable wheels of the vehicle. However, it would be within the scope of the invention to provide rear steerable wheels. It will be understood that the space necessary to accommodate a steerable wheel is greater than the space required to accommodate a non-steerable wheel. Thus, the provision of a steerable front wheel imposes on the dimensions of the adjacent hollow structure greater limitations than does the provision of a non-steerable rear wheel.

The hollow structures 13 and 14 contain means for dissipating kinetic energy upon deformation. The means for dissipating kinetic energy may comprise a fluid, either a gas or a liquid. Alternatively, the means for dissipating kinetic energy may comprise a structure formed of solid materials, for example metals or plastics materials, arranged in a manner which adapts the materials for progressive collapse. A honeycomb structure is an example of such an arrangement. A representative example of means comprising a fluid is shown diagrammatically in Figure 8, where a piston and cylinder unit 37 is shown with its longitudinal axis coinciding with the longitudinal axis of the middle member of the hollow structure. Means is provided for transmitting force along that axis

between the front member of the hollow structure and one of the piston and cylinder and for transmitting force along the axis between the rear member of the hollow structure and the other of the piston and cylinder. The piston and cylinder unit is arranged in a known manner to operate as a damper. Alternatively, the middle member of the hollow structure may be formed as the cylinder and the front member and the rear member both formed as pistons sliding in the middle member. A compressible structure may be interposed between the front and rear members. The compressible structure may include a bag containing air or other gas or a mass of compressible material, for example a foamed plastics material or a honeycomb or like structure. A foamed plastics material or a honeycomb structure will provide yieldable support to the middle member of the hollow structure against lateral collapse of the middle member under the action of an externally applied force. It will be understood that the end members of the hollow structures also may contain a foamed plastics material or a honeycomb or like structure or other means for resisting collapse and dissipating kinetic energy upon collapse.

In the vehicle illustrated in Figures 1, 2 and 3, the middle members 18 and 23 are substantially cylindrical, are spaced 500mm to 900mm apart and have a diameter of 300mm to 500mm. The vehicle may be modified as illustrated in Figure 4 by modifying the transverse cross section of the middle members 18 and 23, at least adjacent to the extensions 33 and 34. Figure 4 shows that the interface between a middle member and its extension is at least approximately flat so that the profile of the middle member is substantially D-shaped. The transverse cross sectional shape of the extension is substantially rectangular.

In the event of impact at the front of the vehicle, the front end member 25 and the front members 19 and 22 will move relative to the middle members 18 and 23. Such movement will be opposed and kinetic energy will be dissipated. Similarly, an impact on the rear of the vehicle will cause the rear end member 26 and the rear members 20 and 24 to move relative to the middle members 18 and 23, such movement will be opposed and kinetic energy will be

dissipated. Oblique impacts on corners of the vehicle or offset head-on impacts also will cause movement of one or other of the end members relative to the middle members and kinetic energy will be dissipated in a similar way.

The connection between the engine mounting 25 and the body of the vehicle may include at least one pivot which will permit unequal displacements of the right-hand and left-hand extremities of the engine relative to the body of the vehicle during impact of the vehicle. This arrangement would be advantageous in the event of impact with one front corner of the vehicle, that is an offset head-on impact. During normal use of the vehicle, pivoting of the engine relative to the body may be restrained by at least one shear pin or other components adapted to yield during impact.

The front end member 25 and the means for mounting the motor, at least when this is in the form of an internal combustion engine mounted near to the front of the body, are arranged to force the engine and gearbox downwards and rearwards in an impact so that the engine goes beneath the floor 17.

In the example of vehicle illustrated in Figures 1, 2 and 3 respective centres of the front and rear seats lie substantially on a longitudinal centre-line of the body 12 of the vehicle. The backrest 29 of the front seat is interposed between the passenger and the driver. Both backrests may be inclined to the vertical, preferably at substantially the same angle so that the backrests are at least approximately parallel to each other. The perpendicular distance between the backrests may be greater than the width of lower part 30 of the front seat. With the arrangement of Figures 1, 2 and 3, the backrest 29 will generally lie between the knees of the passenger.

The vehicle may be modified to provide the arrangement illustrated in Figure 5. In this modified arrangement, the space between the backrests is considerably less than in the case of the vehicle shown in Figures 1, 2 and 3 and the knees of the passenger lie forwards of the backrest 29. Furthermore, the opening between the backrest 29 and the middle member 18 has a considerably greater height then is represented in Figure 2. The extensions for receiving the

legs of the passenger may be markedly tapered, being relatively high adjacent to the backrest 29 and relatively low at their front ends. For example, the height adjacent to the backrest may be at least twice the height adjacent to the front end.

A further modified vehicle is illustrated in Figure 6. In this Figure, parts corresponding to those hereinbefore described with reference to Figures 1, 2 and 3, are identified by like reference numerals with the prefix 1. The preceding description is deemed to apply to the vehicle of Figure 6, except for the differences hereinafter mentioned. Respective centres of the front and rear seats of the vehicle shown in Figure 6 are offset in opposite directions from a longitudinal centreline of the vehicle body. Accordingly, the space for accommodating the legs of the passenger lies entirely at one side of the front seat, lying between that seat and either the middle member 118 or the middle member 123. The backrest 129 of the front seat is preferably incorporated in a bulk head which extends laterally to both of the middle members 118 and 123, an opening being provided between the bulk head and one of the middle members to accept the legs of the passenger. The backrests 127 and 129 both face substantially in the direction of normal travel of the vehicle. As viewed along this direction, the backrests may overlap somewhat with each other.

A further example of a modified vehicle is illustrated in Figure 7 by a view similar to that of Figure 6. In Figure 7, parts corresponding to those hereinbefore described with reference to Figures 1, 2 and 3 are identified by like reference numerals with the prefix 2 and the preceding description of the vehicle is deemed to apply to the vehicle of Figure 7, except for differences hereinafter mentioned.

The seats of the vehicle shown in Figure 7 are offset in opposite directions with respect to a longitudinal centreline of the vehicle but to a smaller extent than is the case in the vehicle of Figure 6. The backrest 229 of the front seat faces in the direction of normal travel of the vehicle. The backrest 127 of the rear seat faces in a direction inclined to the normal direction of travel of the

vehicle at an angle which may be in the range 10° to 30°. The space for accommodating the legs of the passenger is between the front seat and one of the middle members 218 and 223. This one middle member only may be provided with a tubular extension for enclosing the legs of the passenger. A similar tubular extension may be provided in the vehicle of Figure 6. It will be noted that, in the vehicle of Figure 7, the space for accommodating the legs and feet of the passenger may intrude somewhat on the otherwise circular profile of the middle member 218.

Figures 9 and 10 show diagrammatically transverse cross sections of middle members which may be substituted for the middle member 118 of the hollow structure shown in Figure 8. The middle member shown in Figure 9 comprises an assembly of three substantially cylindrical tubes enclosed in a non-circular envelope. The tubes may have different diameters. For example, in the example illustrated in Figure 9, tubes 39 and 40 having the same diameter are stacked one above the other and a tube 41 of smaller diameter lies beside a interface between the larger tubes. The assembly of three tubes may be constructed as an integral body, for example of a reinforced plastics composition.

The example illustrated in Figure 10 comprises a pair of substantially cylindrical tubes enclosed by an envelope 42. Respective webs 43 and 44 may extend from the interface between the tubes to the envelope. The tubes 45 and 46, the envelope 42 and the webs 43 and 44 may all be incorporated in an integral body.

The tubes illustrated in Figures 9 and 10 or some of them may contain energy-absorbing structures, for example a honeycomb structure formed of metal or a foamed plastics material. Different densities, materials and orientations may be used in the various tubes and/or within the same tube. For example, in a tube which forms a part of a hollow structure, there may be provided in opposite end portions of the tube honeycomb structure oriented to provide maximum resistance to collapse under the action of force acting along the tube and, within an

intermediate portion of the tube, honeycomb structure oriented to provide maximum resistance to force acting in a direction towards the axis of the tube.

One or both of the hollow structures of a vehicle may incorporate one or more tubes which have a function additional to the function of yieldably resisting collapse of the tube. For example, an exhaust gas duct or an air duct or a duct for conveying other heat transfer fluid may be incorporated in one of the hollow structures. A hollow structure may comprise a number of tubes arranged with their lengths extending along the hollow structure, one or more of these tubes being arranged as a duct, along which a fluid flows during use of the vehicle. Spaces between the tubes may be occupied by a solid foam. In a hollow structure which comprises a tube or a number of tubes, the or one of the tubes may contain means for absorbing energy in the event of impact, such means being generally as hereinbefore described. A cross section of a representative hollow structure of this kind is shown in Figure 11, where 47 is an envelope of the hollow structure, 48 is a larger diameter tube which constitutes an exhaust gas duct and 49 is an assembly of smaller diameter tubes which contribute to the stiffness of the hollow structure. The tubes 49 may be surrounded by a foamed plastics material which normally holds the tubes 49 in the required positional relation relative to each other and relative to the envelope 47. The hollow structure may comprise a further, larger diameter tube 50 which contains a piston and/or an air-bag for absorbing energy in the event of impact.

Figure 1 shows seat backrests which are substantially upright. The arrangement may be modified to provide inclined backrests. The bulkheads 15 and 16 also may be inclined to the horizontal. The rear seat
may be spaced sufficiently far from the front seat for the passenger to be accommodated entirely behind the front seat. This spacing may be quite small, if the passenger does not extend his legs. In all cases, the seats may be equipped with full harnesses for restraining the occupants. In place of a single rear seat, there may be provided a pair of rear seats to accommodate two children behind the front seat.

In Figure 12 there is shown a diagrammatic representation of a chassis structure of the vehicle embodying the present invention. This structure is of substantially rectangular form and defines a safety cell for receiving the driver and passenger of the vehicle. The longer members of the rectangle 213 and 214 correspond to the hollow structures 13 and 14 of the vehicle shown in Figures 1, 2 and 3. These members may have any of the forms hereinbefore described and shown in the accompanying drawings. The members 213 and 214 are hollow, elongated and contain means for yieldably opposing collapse of these members and thereby absorbing kinetic energy. The shorter members of the rectangle are identified by the reference numerals 215 and 216. These members also are of tubular form and preferably contain means for yieldably resisting collapse of the members. They correspond to the rear bulkhead 15 and front bulkhead 16 of the vehicle shown in Figures 1, 2 and 3. The members 215 and 216 are secured at their ends to the members 213 and 214 adjacent to the ends of the latter members. The ends of the members 213 and 214 are preferably open to receive load-transmitting components which protrude forwards and rearwards from the basic chassis structure and which, in the event of front or rear impact, transmit force to the means inside the members 213 and 214 for yieldably resisting collapse of the structure.

In practical embodiments of the invention, the side members of the basic chassis structure may differ from the simple, cylindrical shape of the members 213 and 214 shown in Figure 12. A first example of such alternative shape is shown in Figure 13. The transverse cross section of the chassis side member shown in Figure 13 is essentially "D" shaped; whereas the corresponding cross sectional shape of the members shown in Figure 12 is circular. Load-transmitting members received in respective end portions of the chassis member 314 shown in Figure 13 and which corresponds to the member 214 of Figure 12 are tapered. Their end portions of larger transverse cross section are received within the member 314 and their end portions of smaller transverse cross section extend forwards and rearwards from the member 314. The tapered members are

identified in Figure 13 by the reference numerals 319 and 320 and correspond functionally to the members 19 and 20 of the vehicle shown in Figures 1, 2 and 3. During manufacture, the members 319 and 320 are secured in fixed positions to the member 314. In the event of front or rear impact, the fixings may yield to permit one or other of the members 319 and 320 to slide inside the member 314.

A further example of a side chassis member which may be incorporated in the basic structure of Figure 12 is illustrated in Figure 14. This chassis member has opposite end portions of tapered form and an intermediate portion of uniform transverse cross section. The overall shape and function of the member shown in Figure 14 is essentially the same as that of the assembly 314, 319 and 320 shown in Figure 13. However, the member 414 shown in Figure 14 does not comprise telescopically arranged parts. In the event of front or rear impact, one or other of the tapered end portions collapses progressively whilst the intermediate portion is not substantially deformed.

In the assembled vehicle, the tapered end portions of the member 414 shown in Figure 14 and the members 319 and 320 of the structure shown in Figure 13 are connected with suspension components of the vehicle, by means of which the chassis structure is supported from the wheels.

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

CLAIMS:

1. A vehicle defining an internal space for accommodating a person and comprising right hand and left hand hollow structures which are spaced apart in a direction transverse to the direction of normal travel of the vehicle and a seat for supporting the person in a position between the hollow structures, wherein the hollow structures extend forwards and rearwards beyond the space for accommodating the person.

2. A vehicle defining an internal space for accommodating two persons and comprising right and left hand hollow structures which are spaced apart in a direction transverse to the direction of normal travel of the vehicle and first and second seats disposed one behind the other for supporting the persons in respective positions between the hollow structures, wherein the hollow structures extend forwards and rearwards beyond the space for accommodating the two persons.

3. A vehicle according to Claim 1 or Claim 2 wherein the height of the hollow structures is more than ¼ of the height of the or each seat.

4. A vehicle according to any preceding claim wherein the width of each hollow structure is more than one tenth of the distance between the hollow structures.

5. A vehicle according to Claim 2 or according to either of Claims 3 and 4, as appendant to Claim 2, wherein there is between each hollow structure and a front one of the seats a respective space to accommodate a corresponding leg of a person supported by the rear seat.

6. A vehicle according to Claim 5 wherein each of said hollow structures has an external, elongated, tubular extension projecting from the hollow structure towards the other hollow structure and arranged with its length approximately parallel to the direction of normal travel, the extension being open at least its rear end and lying at least partly between the front seat and the hollow structure.

7. A vehicle according to any preceding claim which has a floor extending between lower margins of the hollow structures.

8. A vehicle according to Claim 7 wherein the floor is substantially flat.

9. A vehicle according to Claim 7 wherein the floor is substantially convex towards the ground.

10. A vehicle according to any preceding claim further comprising front and rear end members spanning the gap between the hollow structures.

11. A vehicle according to Claim 10 wherein the end members have respective connectors in telescopic relation with respective ones of the hollow structures.

12. A vehicle according to Claim 11 wherein there is associated with the connectors means for transmitting between the end members and the hollow structures forces acting in directions parallel to or inclined to the direction of normal travel.

13. A vehicle according to any preceding claim wherein the distance from the or each seat to external surfaces of the vehicle beside the seat is, at both sides of the seat, more than one half of the width of the seat.

14. A vehicle according to Claim 2 wherein there are between the hollow structures and a front one of the seats spaces for accommodating the legs of a person occupying the rear seat and wherein the front seat includes a back which, when the seats are both occupied, is interposed between the occupants of the seats.

15. A vehicle according to Claim 1 or Claim 2 wherein, when the vehicle stands on a horizontal surface a maximum width of the vehicle occurs at a level spaced above that surface by a distance which is more than the vertical dimension of each of said structures or more than the maximum vertical dimension of each of said structures.

16. A wheeled vehicle according to Claim 2 wherein respective persons occupy the seats, the legs of the person occupying the rear seat lie at opposite sides of the front seat and wherein a back of the front seat lies between the persons.

17. A wheeled vehicle comprising a safety cell for containing an occupant or occupants of the vehicle wherein the cell comprises four elongated, hollow structures arranged substantially to define a rectangle and connected to each other and wherein at least two of said structures contain means for yieldably resisting collapse of the hollow structure.

18. A vehicle according to Claim 17 wherein said four hollow structures collectively form a chassis which supports the occupant or occupants from the wheels of the vehicle.

19. A vehicle according to Claim 17 or Claim 18 wherein at least two of said hollow structures are at least part-cylindrical.

20. A wheeled vehicle according to any one of Claims 17 to 19 wherein said two hollow structures contain respective elements connected with suspension components of the vehicle lying outside the hollow structures.

21. A vehicle according to any preceding claim wherein the or each seat includes a back rest which extends substantially to the top of said internal space.

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Databases (see over)

(i) UK Patent Office

(ii)

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Documents considered relevant following a search in respect of claims 1-16

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	GB 1567650 (BUDD) NOTE HOLLOW STRUCTURES DEFINED BY MEMBERS 10, 25, 26	1, 2, 7, 8 AT LEAST
X	GB 0883565 (HARDY) NOTE TUBULAR SIDE MEMBERS PROVIDED BY MEMBER 1	1, 2, 7, 10 AT LEAST
X	GB 0710463 (DAIMLER-BENZ) NOTE SIDE BODY PORTIONS 1	1, 2, 3, 4 AT LEAST
X	GB 0660528 (TARTUFFI) NOTE NACELLES 1, 1'	1, 3, 4, 10, 13 AT LEAST
X	GB 0502234 (DAIMLER-BENZ) NOTE HOLLOW STRUCTURES DEFINED BY SKIN M	1, 3, 4, 7, 9 AT LEAST
X	US 3848886 (FEUSTEL) NOTE LONGITUDINAL SIDE FRAME MEMBERS	1, 2 AT LEAST

Category	Identification of document and relevant passages	Relevant to claim(s)

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